PATENT SPECIFICATION

(11) 1241744

1241744

DRAWINGS ATTACHED

(21) Application No. 39182/69 (22) Filed 5 Aug. 1969
(31) Convention Application No. A277 (32) Filed 13 Jan. 1969
(31) Convention Application No. A4816 (32) Filed 21 May 1969 in
(33) Austria (OE)
(45) Complete Specification published 4 Aug. 1971
(51) International Classification F 16 h 5/16
(52) Index at acceptance
F2D 13G1C 7C6
F2C 1C4B 1C9B2 1D 1E3 1E7

(54) A TRANSMISSION FOR AGRICULTURAL TRACTORS

(71) We, STEYR-DAIMLER-PUCH AKTIENGESELLSCHAFT, an Austrian Body Corporate, of Kärntnerring 7, Vienna, Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a transmission for agricultural tractors, and comprises two hydraulically operated friction clutches, which consist preferably of multiple-disc clutches.

In known transmission of that kind, each of the two friction clutches or multiple-disc clutches is held in a disengaged position by a coil spring or a plurality of small coil springs. To engage the clutch, the piston of one clutch or the other must be moved by the hydraulic fluid against the force of the spring or springs. Each piston must be provided with separate conduits for supplying and discharging the hydraulic fluid. The main disadvantage of the known transmission resides in that a failure of the hydraulic pump or a leak in the hydraulic conduit causes both clutches to be disengaged by the spring force so that the transmission of power is entirely interrupted. When the engine is defect or the hydraulic pump has failed, it is no longer possible to brake the tractor with the aid of the engine during downhill travel. Besides, the engine cannot be started in that the tractor is towed because both clutches are disengaged so that there is no longer a driving connection from the rear wheels of the tractor.

In another known design, the two multiple-disc clutches are strictly mechanically operable by a common sliding sleeve. This arrangement has the disadvantage that the sleeve cannot be shifted without an interruption of the traction because the sleeve moves through a neutral position from the position in which one clutch is first disengaged and the position in which the other clutch is first engaged. The arrangement might be such that one clutch begins to slip before the other has been entirely disengaged. In that case, however, there will be no neutral position in which both clutches are disengaged so that the wear of the clutches will be increased.

It is an object of the invention to eliminate these disadvantages and to provide a transmission which is of the type defined first hereinbefore and in which a lack of the hydraulic pressure required to operate the clutches will not interrupt the driving connection between the engine and the driving wheels of the tractor and further advantages are afforded.

The invention accomplishes its object essentially in that one friction clutch is provided with a spring tending to hold the clutch engaged and the other friction clutch is provided with a spring tending to disengage the clutch. In case of a lack of the hydraulic pressure required to operate the clutch because the engine has stopped or there is a leak in the hydraulic conduit, one of the two friction clutches will be disengaged and the other friction clutch will be held engaged so that the driving connection is not interrupted. If the hydraulic conduit is damaged, the tractor can continue to travel without using one stage of the transmission. In the case of a defect of the engine, the tractor can be stopped in that one gear of the main transmission is engaged. The engine can be started in that the tractor is towed; this is particularly important in the cold season.

In a development of the invention, the friction clutch provided with the spring which tends to hold the clutch engaged is associated with that stage of the transmission which has a lower transmission ratio. Torque will be transmitted by that clutch at higher speeds than by the other stage of the transmission and the spring which exerts the clutch-engaging pressure may be weaker and have smaller dimensions. Because the spring is weaker, the area and diameter of the piston

to disengage the clutch against spring force are also reduced. The reduction of these dimensions results in a saving of material and in a reduction of the rotating masses so that the shifting is facilitated.

The spring which holds the friction clutch in coupling position consists of a set of plate springs. Such a set of plate springs has the advantage that it can produce higher spring forces within a given space and that it has a much flatter spring characteristic than a coil spring. For this reason, a wear of the friction facings will reduce the spring force only to an insignificant extent. The spring of the other clutch may consist of an inexpensive coil spring because it need not exert the clutch-engaging pressure but serves only to keep the friction faces apart.

The design according to the invention in which pressure is applied to both pistons in order to disengage one clutch and engage the other and the hydraulic fluid is discharged from both pistons to perform the opposite shifting operation enables the use of an arrangement in which the pistons of both friction clutches are provided with a common conduit for the supply and discharge of the hydraulic fluid so that the design is simplified. If the drive of the succeeding main transmission is to be interrupted entirely, e.g., when the tractor is standing still, and a clogging in the attached implement is to be eliminated in that the drive of the same is continued from a power take-off shaft, the first-mentioned clutch must be disengaged by the action of hydraulic pressure and the second clutch must remain pressure-relieved. In this case, each piston must be provided with a separate conduit for supplying and discharging hydraulic fluid.

It has been found in practice that it would be desirable to enable a shifting under load within a larger range of transmission ratios so that the transmission of power will not be interrupted when the transmission is shifted in that range when the tractor is working in the field, whereas the succeeding main transmission, which is mainly used during road travel, may have a smaller number of gears.

For this reason it is a development of the invention to provide an additional pair of spur gears for a third transmission stage having a higher transmission ratio than the other two stages, and an overrunning clutch for connecting one of said spur gears to the associated shaft. This transmission comprises three transmission stages so that it can be shifted under load within a much larger range of transmission ratios and the number of gears in the main transmission can be reduced accordingly. Because one spur gear is connected to its shaft by an overrunning clutch and this spur gear belongs to the transmission stage having the highest transmission ratio and used for the lowest speed of travel, the torque-transmitting connection between said spur gear and its shaft will be automatically eliminated as soon as one of the two other transmission stages is connected by means of the respective friction clutch. The overrunning clutch may consist of a free-wheel, which automatically begins to transmit power when the two friction clutches for the transmission stages for the higher speeds have been disengaged.

This arrangement would have the disadvantage that the overrunning clutch will automatically interrupt the transmission of power when the tractor engine is to be used to brake and the speed of the shaft driven by the drive wheel of the tractor is increased so that there is a speed difference between the two parts of the free-wheel. In such case, the engine could not be used to brake unless one of the other two transmission stages has been connected. The tractor driver may not always be expected to make the required shift and this shift would even be undesirable because the other two transmission stages have smaller transmission ratios, which are less desirable when the engine is used to brake the tractor. To eliminate this disadvantage, it is a feature of the invention that the overrunning clutch consists of a dog clutch and can be engaged and held in engaged position by a hydraulically operable piston. Known means may be used to delay the pressure build-up taking place in response to the engagement of the clutch to such an extent that the synchronizing effect will not be lost. When a synchronism between the driving and driven members of the clutch has been reached and the dogs have engaged, the hydraulic pressure applied to the clutch-engaging piston acts like a barrier which prevents a separation of the clutch dogs until a predetermined torque has been reached. Such a clutch can readily be used when the engine is required to brake. When the one piston is pressure-relieved, the overrunning effect will be produced to disengage the clutch in response to the required speed difference.

A particularly suitable design will be obtained if the overrunning clutch is carried by the same shaft as the friction clutches because in this case the supply and discharge conduits for all three pistons may be formed by bores in the same shaft and a compact, space-saving arrangement results. It will be understood that the supply of pressure fluid to the fluid to the three pistons must be controlled so that only one of the friction clutches and overrunning clutch are in engaged position.

Figs. 1 and 2 of the accompanying drawings are sectional views showing by way of example two embodiments of a transmission for an agricultural tractor.

In Fig. 1 an input shaft 1, is driven from the engine by a main clutch. A lay shaft 4 is driven from the input shaft 1 by a pair of spur gears 2, 3. The lay shaft drives by a pair of gears 5, 6 the clutch drum 7 of a multiple-disc clutch generally designated 8. The driven member 9 of the clutch 8 is fixed to the output shaft 10 of the transmission. The end of the output shaft 10 is freely rotatably mounted in the input shaft 1 and drives the main transmission, which is not shown. The drum 11 of another friction clutch 12 is non-rotatably connected to the pinion 2. The driven member 13 of the clutch 12 is non-rotatably mounted on the output shaft 10. The member 13 of the multiple-disc clutch 12 is biased by a set of plate springs 14, which forces the clutch discs against each other to hold the clutch 12 engaged. The clutch 8 is provided with a coil spring 15, which tends to urge the clutch discs apart and thus to disengage the clutch. The member 13 of the clutch 12 forms a piston, which is slidable in a cylinder 16, which is axially fixed on the shaft 10. The cylinder 16 consists of a double cylinder and contains another piston 17, which acts also as a pressure ring acting on the discs of the clutch 8 and is displaceable against the force of the spring 15. A common conduit 18 for a supply and discharge of oil is connected to the end faces of the pistons 13, 17.

In the position shown in Fig. 1, the clutch 12 is engaged and the clutch 8 is disengaged. Power is transmitted from the shaft 1 through the clutch drum 11, the discs of the clutch 12 and the member 13 directly to the output shaft 10. When oil under pressure from conduit 18 is supplied to both pistons 13, 17, the clutch 12 will be disengaged whereas the clutch 8 is engaged at the same time so that power is then transmitted from the input shaft 1 through the pair of spur gears 2, 3, the lay shaft 4, the pair of spur gears 5, 6, the clutch drum 7, the discs of the clutch 8 and the member 9 to the output shaft 10. If the conduit 18 is connected to the return conduit, the springs 14, 15 will automatically cause the transmission to assume the position shown in the drawing. Hence, a lack of oil pressure will automatically result in the transmission of power along the path described first.

In the embodiment of Fig. 2, the pressure ring for the discs of the clutch 8 forms a piston 17, which is slidable in a spur gear 19, which is freely rotatable on the shaft 10 and a cylinder. The spur gear 19 is in mesh with a spur gear 20, which is secured to the lay shaft 4. An overrunning clutch consisting of a dog clutch serves to connect the spur gear 19 to the output shaft 10. One clutch member consists of the spur gear 19 itself, the other clutch member 21 is non-rotatably mounted on the shaft 10 but axially slidable thereon. The member 21 forms a piston, which is received by a cylindrical bore of the driven member 9 of the multiple-disc clutch 8. To apply hydraulic pressure to the pistons 13, 17, and 21, the cylinders 16, 19, and 9 are supplied with oil under pressure from time to time through bores which are not shown.

In the position shown in Fig. 2 the clutch 12 is engaged and the clutch 8 and the overrunning clutch are disengaged. Just as in the embodiment of Fig. 1, power is transmitted directly from the shaft 1 through the clutch 12 to the output shaft 10. If oil under pressure is supplied to the piston 13 in the cylinder 16 and to the piston 17 in the cylinder formed by the spur gear 19, the clutch 12 will be disengaged whereas the clutch 8 is engaged so that power transmitted from the input shaft 1 through the pair of spur gears 2, 3, the lay shaft 4, the pair of spur gears 5, 6, and the clutch 8 to the output shaft 10. When the application of pressure to the piston 13 in the cylinder 16 is maintained, the cylindrical space of the spur gear 19 containing the piston 17 is connected to the return conduit and pressure oil is additionally supplied to the piston 21 in the clindrical space formed by the member 9. This will cause the overrunning clutch to be engaged so that power is now transmitted from the shaft 1 through the pair of spur gears 2, 3, the lay shaft 4, the pair of spur gears 20, 19 and the overrunning clutch to the shaft 10. It is apparent that this is that stage of the transmission which has the highest transmission ratio and results in the lowest speed of travel.

WHAT WE CLAIM IS:—

1. A transmission for agricultural tractors comprising two hydraulically operated clutches associated one with each transmission stage, one friction clutch being engageable by spring force and having a hydraulically operated piston operable to effect clutch disengagement the other friction clutch being disengageable by spring force and also having a hydraulically operated piston operable to effect clutch engagement.

2. A transmission as claimed in claim 1 wherein the friction clutch engaged by spring force is associated with that stage of the transmission which has a lower transmission ratio.

3. A transmission as claimed in claim 1 or 2, wherein the spring force which holds the friction clutch engaged is provided by a set of plate springs.

4. A transmission as claimed in any one of the preceding claims wherein friction clutches are multiplate clutches.

5. A transmission as claimed in any one of the preceding claims wherein a common conduit is provided for the supply and discharge

of the hydraulic fluid to the pistons of the clutches.

6. A transmission as claimed in any one of the preceding claims further including an additional pair of spur gears for a third transmission stage having a higher transmission ratio than the other two stages, and an overrunning clutch for connecting one of said spur gears to an output shaft.

7. A transmission as claimed in claim 6, wherein the overrunning clutch consists of a dog clutch which is engageable and held in the engaged position by a hydraulically operable piston.

8. A transmission as claimed in claim 6 or 7 wherein the overrunning clutch is carried by the same shaft as the friction clutches.

9. A transmission for agricultural tractors, substantially as described hereinbefore with reference to or as shown in Figures 1 or 2 of the accompanying drawings.

10. An agricultural tractor including a transmission as claimed in any one of the preceding claims.

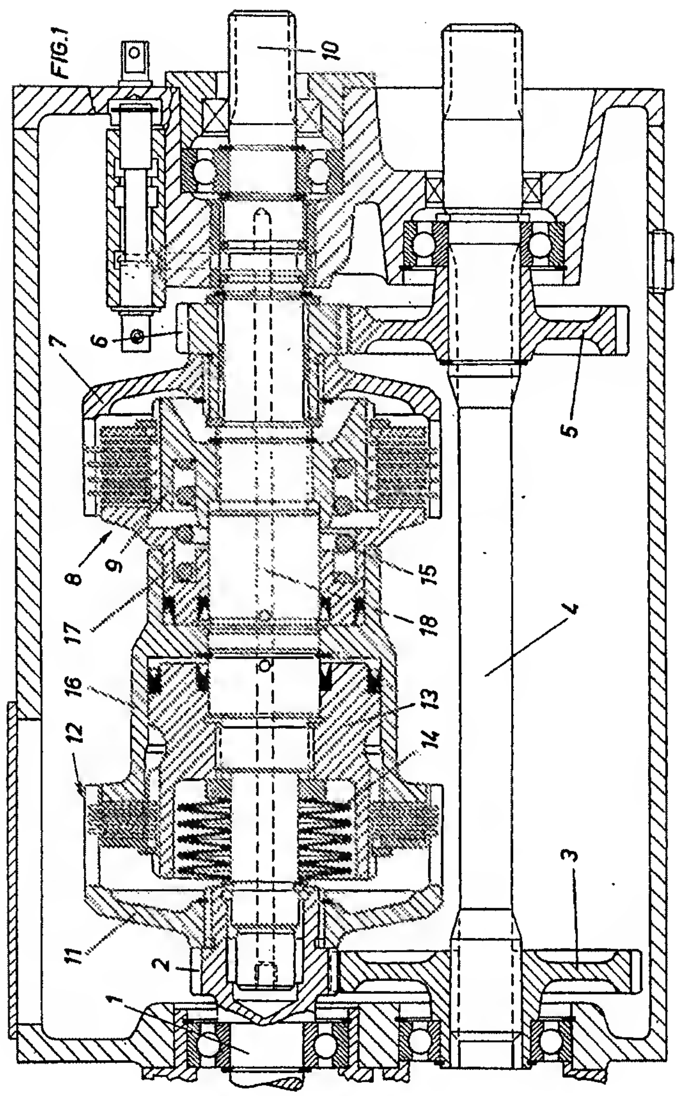
For the Applicants:—
F. J. CLEVELAND & COMPANY,
Chartered Patent Agents,
Lincoln's Inn Chambers,
40/43 Chancery Lane,
London, WC2A 1JQ.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1241744 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1



1241744 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

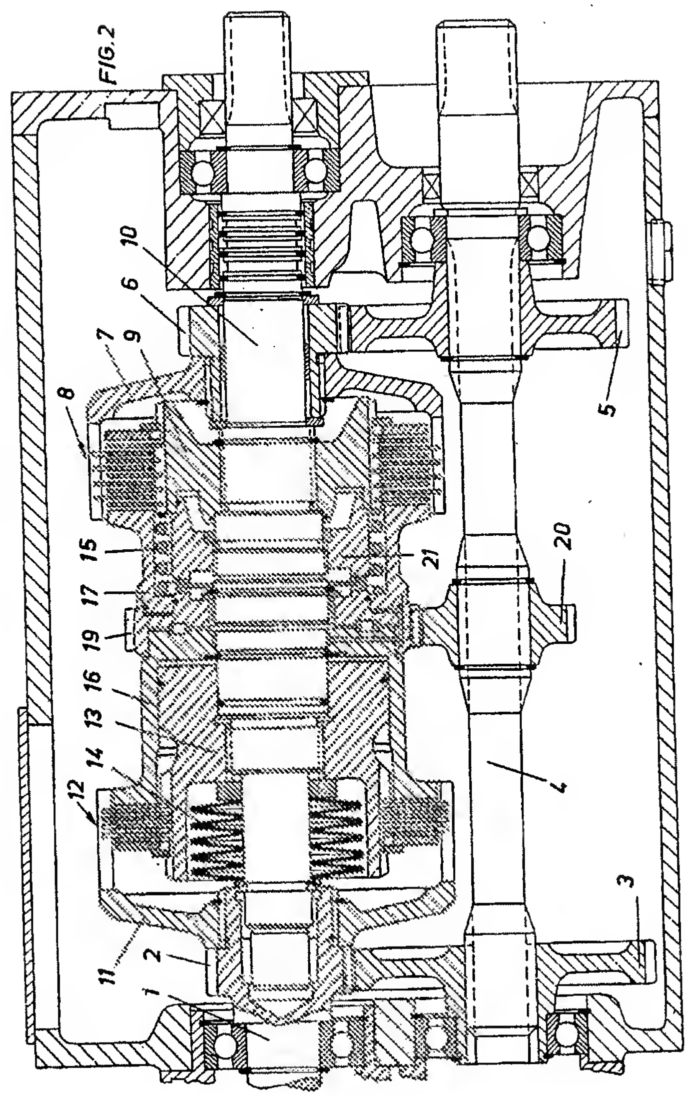


FIG. 2